

## The Genus *Pedronia* Green in Hawaii, with Descriptions of New Species (Homoptera: Pseudococcidae)

JOHN W. BEARDSLEY

EXPERIMENT STATION, H.S.P.A.  
HONOLULU, HAWAII

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As Zimmerman (1948) has pointed out, the endemic pseudococcid fauna of the Hawaiian Islands, although it is poorly known, contains a number of unusual and interesting forms. One such species is *Pedronia hawaiiensis* Ferris, which was described from a single small collection taken from the fronds of the widespread and pestiferous exotic fern *Dicranopteris linearis* (Burmeister) Underwood. Four additional species allied to *P. hawaiiensis* have been discovered recently and are described in this paper. Still others in this group doubtless await discovery by careful collectors, particularly on the islands other than Oahu. These mealybugs are not likely to be taken in the course of indiscriminate general insect collecting as their small size and cryptic habits render them very inconspicuous. Two of the species described here were found on the slopes of Mt. Tantalus, Oahu, which is probably one of the most thoroughly collected areas in the Hawaiian Islands. Two species are known only from herbarium specimens of their hosts.

All the Hawaiian members of the genus *Pedronia* so far discovered are attached to ferns. Four have been found associated with false staghorn ferns (*Dicranopteris* spp.) and one with a tree fern, *Cibotium chamissoi* Kaulfuss. That two species are known only from the exotic *D. linearis* seems an unusual host relationship for what appear to be endemic Hawaiian insects. Presumably, the original hosts of these mealybugs were native species of *Dicranopteris* or other native ferns, and they have successfully adapted themselves to the immigrant species. It is likely that these mealybugs eventually will be found infesting native hosts.

The genus *Pedronia* was erected by Green (1922) to receive a single species, *P. strobilanthis* Green, from Ceylon. The host of the genotype is given as *Strobilanthis* sp., a member of the spermatophyte family Acanthaceae. Ferris (1948) redefined the genus and described the second known species, *P. hawaiiensis*, from Oahu. Professor Ferris has very kindly examined specimens of the first two species described here and considers them congeneric with *P. hawaiiensis*. It seems possible that the Hawaiian species are not closely allied to the Ceylonese genotype, and, perhaps, ultimately a new genus

should be erected for them. However, following Professor Ferris' suggestion, I am broadening the concept of the genus *Pedronia* to accommodate the newly discovered forms.

As understood here, the genus *Pedronia* includes pseudococcids that possess two to seventeen definite pairs of cerarii. Some cerarii, at least the posterior two to four pairs in the known species, have two or more large, stout, conical setae set close together. Such setae are also present in rows on the dorsum in the genotype but not in any known Hawaiian species. Antennae six- or seven-segmented. Tarsal claws without a tooth.

Dorsal ostioles usually present, but reduced or apparently absent in mature females of some Hawaiian forms. Circulus entirely wanting in all known species. Tubular ducts absent in all species; multilocular disc pores absent in all known Hawaiian forms, but small numbers of these present in the genotype (Ferris, 1948). Trilocular pores present on the venter and usually on the dorsum. In two of the Hawaiian species the number of dorsal triloculars is reduced to a very few. Anal ring small but well developed, bearing the usual six setae.

The distinctive features of the genus seem to be the presence of the unusually large, stout, conical setae associated with at least some of the cerarii, and the absence of circuli and tubular ducts. The known Hawaiian species differ from the Ceylonese genotype in that they all apparently lack multilocular disc pores and stout conical setae on the dorsum. However, in two of our species most of the dorsal setae are enlarged, their basal diameter being considerably greater than that of ordinary body setae. The Hawaiian species all show some tendency to develop sclerotized prominences which bear those cerarii that possess the larger conical setae. In one of the species which is described here the entire derm becomes heavily sclerotized at full maturity.

Trilocular pores are present on at least the anal pair of cerarii in all but one of the known Hawaiian species. In three of our species several such pores are situated between and around the larger conical setae of the more strongly developed cerarii. These pores are probably the orifices through which the wax pencils associated with these cerarii are secreted.

KEY TO THE KNOWN HAWAIIAN SPECIES OF PEDRONIA

- 1. Anal cerarii each with seven or more stout accessory conical setae which extend in an arc nearly to, or across, the mid-dorsal line of the ninth abdominal segment anterior to the anus; dorsal body setae of abdomen enlarged . . . . . 2
- Anal cerarii each with but two large conical setae; dorsal body setae of normal form . . . . . 3
- 2. With but two pairs of abdominal cerarii bearing stout conical setae;

- accessory conical setae of ninth abdominal segment of nearly uniform size, forming a closely packed phalanx which extends across the mid-dorsal line; trilocular pores numerous on anterior portion of dorsum . . . . . *acanthocauda*, n. sp.  
 With seven or eight pairs of abdominal cerarii bearing stout conical setae; accessory conical setae of posterior margin of ninth abdominal segment becoming smaller toward the mid-dorsal line, where they are usually discontinuous; trilocular pores of dorsum very few . . . . . *crypta*, n. sp.
3. With seventeen definite pairs of cerarii, all except the anal pair normally with four large conical setae (although the number on anterior pairs may vary from three to five); on *Cibotium* . . . *cibotii*, n. sp.  
 With sixteen or fewer definite pairs of cerarii, each normally bearing two conical setae; on *Dicranopteris* . . . . . 4
4. With sixteen definite pairs of cerarii, the conical setae of all of about equal size; sclerotization of derm at full maturity confined to cerarii; without cephalic humps . . . . . *hawaiiensis* Ferris  
 With eleven to fourteen pairs of cerarii, conical setae of those anterior to the last three or four reduced, variable, or absent; derm completely sclerotized at full maturity; with a rounded cephalic hump bearing a cerarius at its apex located on either side of the midline between the antennae . . . . . *dura*, n. sp.

### *Pedronia hawaiiensis* Ferris

I have collected this species on the Manoa Cliff Trail, Mt. Tantalus, Oahu; Wiliwilinui Ridge, Oahu; and on Mt. Kaala, Oahu. A few trilocular pores, usually from two to six, are present on each cerarius around the bases of the conical setae of all my specimens. These are not indicated in Ferris' figure, but are present on the paratype specimens at the Bishop Museum. In one specimen from Wiliwilinui Ridge there are three conical setae on one of the anterior cerarii.

Wherever I have found this species it has been associated with a particular deformation of the fronds of the host fern, *Dicranopteris linearis*. This takes the form of a rosette of pinnules and is produced by the tight coiling of the midrib of a branch pinna (fig. 1). The mealybugs are usually found within these rosettes, particularly on the undersurfaces of the pinnules near the midrib. Whether this deformation is actually a result of the feeding of the mealybugs or whether they merely take advantage of the concealment which the deformed fronds afford was not determined.

Mature living females of *Pedronia hawaiiensis* are pale yellow in color, oval in outline, and quite flat. The dorsal surface is smooth, shining, and almost devoid of mealy wax. Two rather thick pencils of glassy wax extend from each cerarius. These lie together so as to appear as a single, wide, longi-

tuinally divided pencil. The length of the longest wax pencils is equal to about one-third the width of the dorsum, but is shorter in immature individuals. Except for the anterior three or four pairs, these wax pencils are all directed posteriorly, and those in the midregion lie close to and nearly parallel with the lateral margins of the body. This unusual arrangement of the wax pencils appears to be due to the posteriorly directed orientation of the cerarian conical setae.

Mature females are about 1.5 mm. long and just under 1 mm. wide. There is usually a small amount of powdery wax on the pinnule surface beneath gravid females, but no sign of any ovisac. This appears to be an ovoviviparous species, as no eggs were ever found. Male cocoons were commonly found with females within coils of deformed pinnules, and a number of small, gray, winged males were reared.

A tiny black species of *Anagyrus*, probably an undescribed endemic form, was reared from females of *Pedronia hawaiiensis* collected on Mt. Tantalus and Wiliwilinui Ridge, Oahu. The larvae of a cecidomyiid midge, determined by Dr. D. E. Hardy as *Trisopsis* sp., were found preying on these mealybugs in *Dicranopteris* fronds from Mt. Tantalus.

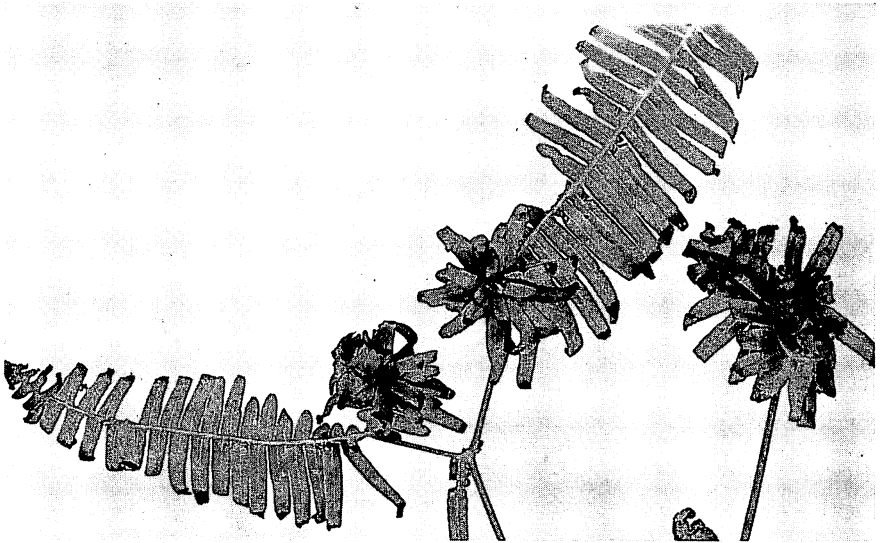


FIG. 1. Rosette deformation of *Dicranopteris linearis* fronds associated with presence of *Pedronia hawaiiensis* Ferris.

**Pedronia cibotii**, new species (fig. 2)

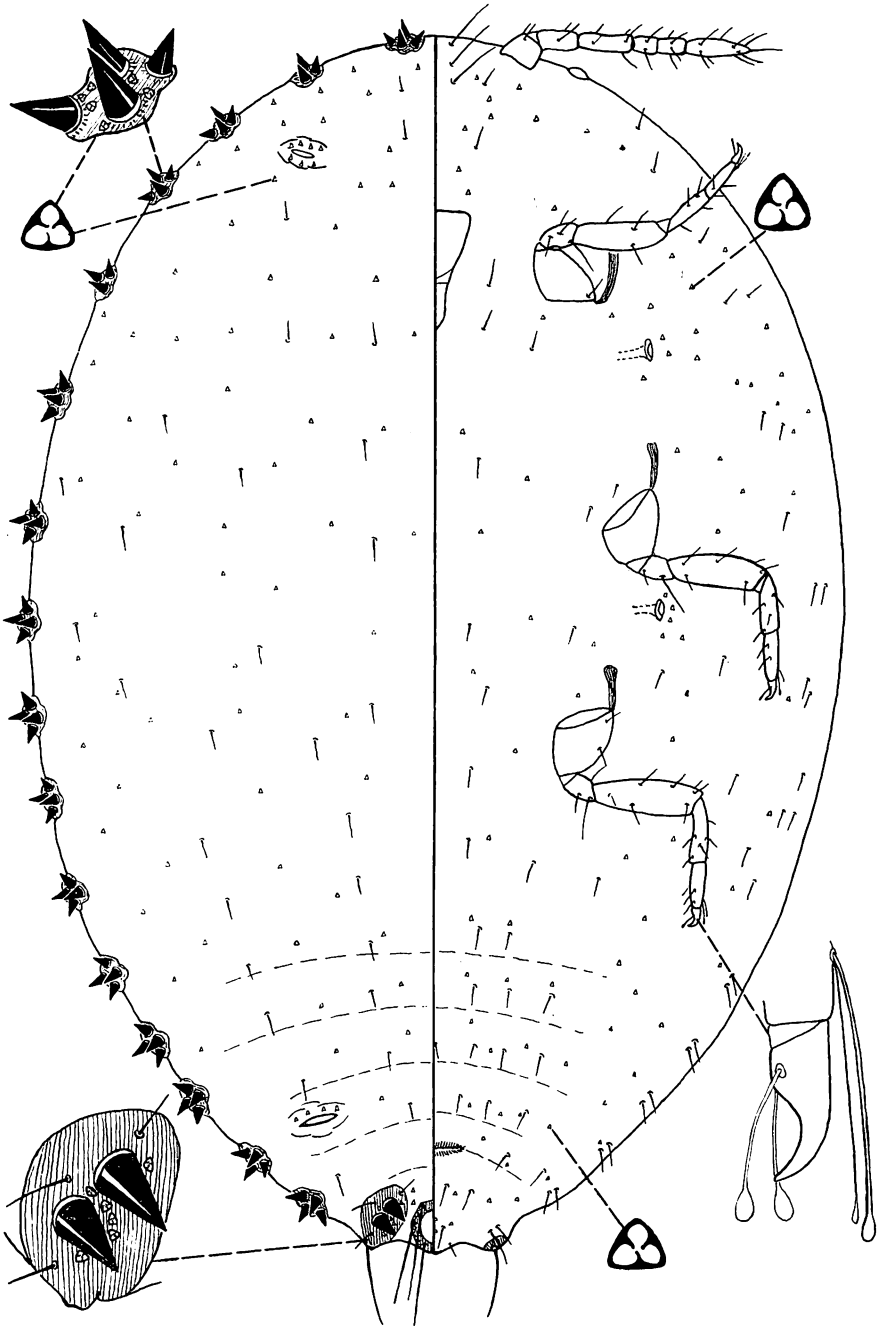
Female. With seventeen definite pairs of cerarii, each, excepting the anal pair, borne on a low, rounded, slightly sclerotized prominence. Anal cerarii each with two large, stout, conical setae, surrounded by an elongate-oval sclerotized area bearing two or three slender accessory setae. Remaining cerarii each typically with four stout conical setae, the two central ones slightly larger than the others; occasionally three or five conical setae on some cerarii, particularly those on the head and thorax. Dorsum and venter with scattered small trilocular pores, a few such pores present on each cerarius around the bases of the conical setae. Ventral side of anal lobes slightly sclerotized at apex. Dorsum and venter with scattered slender setae. Antennae six-segmented in all specimens at hand.

Length of last-stage females on slides: 1.2–1.7 mm.

Described from 23 slide-mounted specimens (holotype and 22 paratypes on 12 slides) from tree fern, *Cibotium chamissoi*, Manoa Cliff Trail, Mt. Tantalus, Oahu, January 2 and January 22, 1956, J. W. Beardsley collector. Holotype and 12 paratypes in the collection of the Experiment Station, H.S.P.A., Honolulu; 10 paratypes in the Bernice P. Bishop Museum, Honolulu.

The diameter of the bases of the conical setae of this and the three other new species described in this paper is somewhat less than those of *Pedronia hawaiiensis*, so that these setae appear more slender and elongate. The normal complement of four conical setae per cerarius and the seventeen pairs of cerarii serve to distinguish this species from other members of the genus.

Living mature females of this mealybug are lemon yellow in color, broadly oval in shape, and nearly flat. The dorsum is almost devoid of mealy wax. Short, fine pencils of glassy wax arise from each cerarius. Typically, there are four such wax pencils at each cerarius: a central pair arising from the larger central pair of conical setae, plus an anterior and a posterior pencil from the slightly smaller anterior and posterior setae. The central pair are roughly perpendicular to the body and lie closely appressed throughout their length so that they appear as a single longitudinally divided pencil. The anterior and posterior pencils extend diagonally from the cerarii. The length of the central pencils is equal to about one-sixth the maximum width of the dorsum of the mealybug, while the anterior and posterior pencils are about one-half to two-thirds as long as the central pair. Two wax pencils, which appear as a single longitudinally divided filament, arise from each anal cerarius and extend backward a distance about equal to the length of the longer lateral pencils.



This mealybug was found on the undersurfaces of mature fronds of the host, usually along the midveins of pinnules near where these joined the midrib of a branch pinna. Occasionally, individuals were found along the outer margins of pinnules where the edges had curled over slightly.

This species produces no ovisac and females were observed giving birth to living young. White male cocoons were fairly numerous on the under surface of infested host fronds, and a number of grayish, winged adult males were reared. A tiny black *Anagyris*, another apparently undescribed endemic species, was reared from this mealybug.

### *Pedronia dura*, new species (fig. 3)

Female. With 11 to 14 discernible pairs of cerarii, the three posterior pairs each with two large stout conical setae. Anterior abdominal and thoracic cerarii variable, each usually with a pair of stout conical setae. These setae variable in size but always smaller than those of the last three pairs of cerarii, although those of the sixth abdominal segment may be only slightly smaller. Conical setae of the anterior cerarii sometimes unequal in size; sometimes represented only by a pair of fine setae like those of the dorsum, sometimes with one conical seta and one fine seta; often with one or more pairs of thoracic cerarii entirely absent.

Head with a pair of forward-projecting rounded humps, one on either side of the mid-dorsal line between the antennae; each hump bearing a single cerarius which consists of two stout conical setae, these somewhat smaller than those of the posterior abdominal cerarii. Cerarii lacking in the region of the head and prothorax immediately behind the cephalic humps.

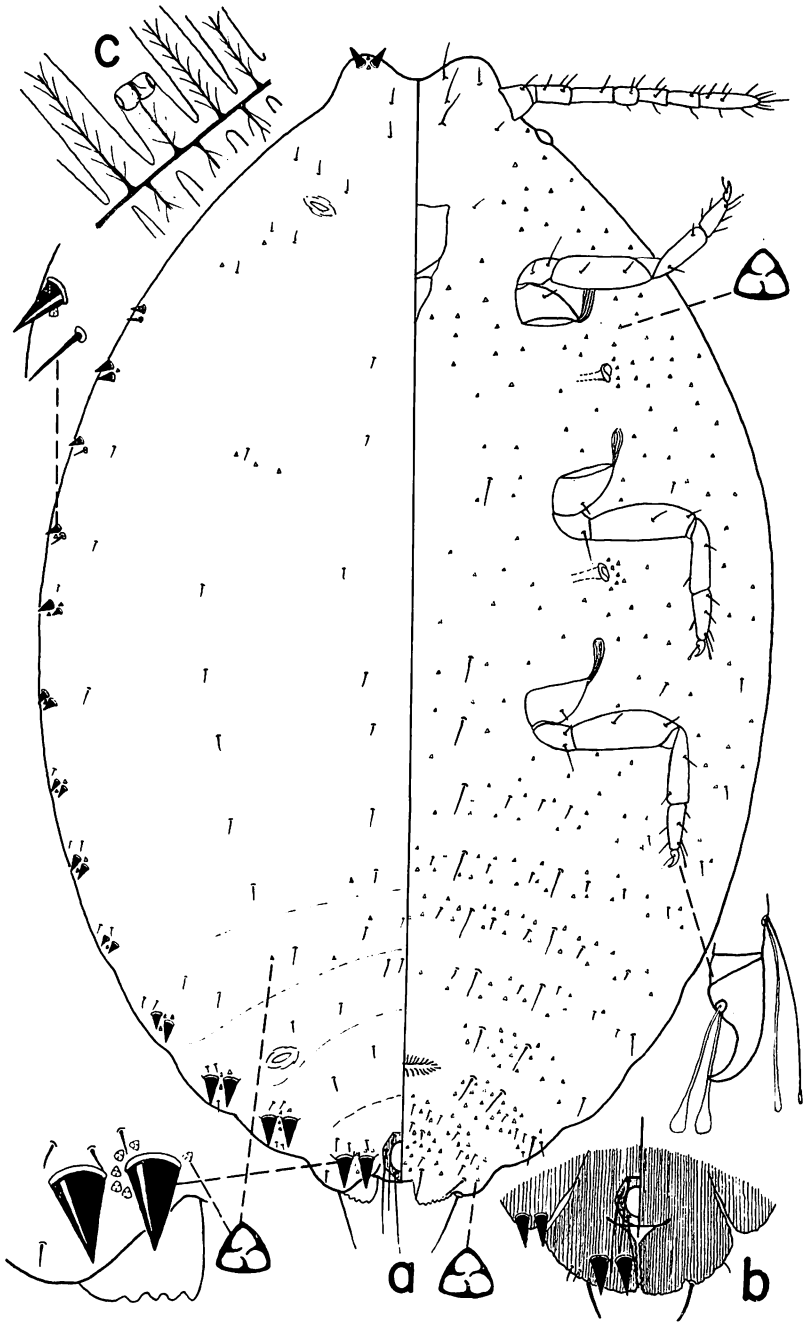
One or more trilocular pores associated with each cerarius; the greatest number on the posterior cerarii, the anal pair each having 6 to 12 such pores. Venter with numerous scattered trilocular pores, somewhat more concentrated posteriorly. Slight concentrations of these pores near the spiracular orifices. Dorsal trilocular pores, other than those associated with the cerarii, reduced to a very few; 2 to 12 or so usually discernible. A few scattered slender setae on dorsum and venter; those of venter of two distinct sizes, the longer ones arranged in incomplete transverse rows.

Derm at full maturity becoming quite heavily sclerotized throughout. Anal lobes of fully mature individuals developing into flattened flap-like projections which meet, or nearly so, along an extension of the mid-dorsal line behind the anus (fig. 3, b). Derm of young last-stage females not sclerotized, the anal lobes less strongly produced, although a thin flap-like extension is usually discernible (fig. 3, a). Antennae with six or seven segments.

Length of last-stage females on slides: 1.4–1.7 mm.

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FIG. 3. *Pedronia dura*, n. sp. a, dorsal and ventral aspects and details of young last-stage female; b, dorsal and ventral aspects of anal lobes of fully mature female; c, portion of a *Dicranopteris linearis* frond showing deformed pinnule associated with presence of *P. dura*.





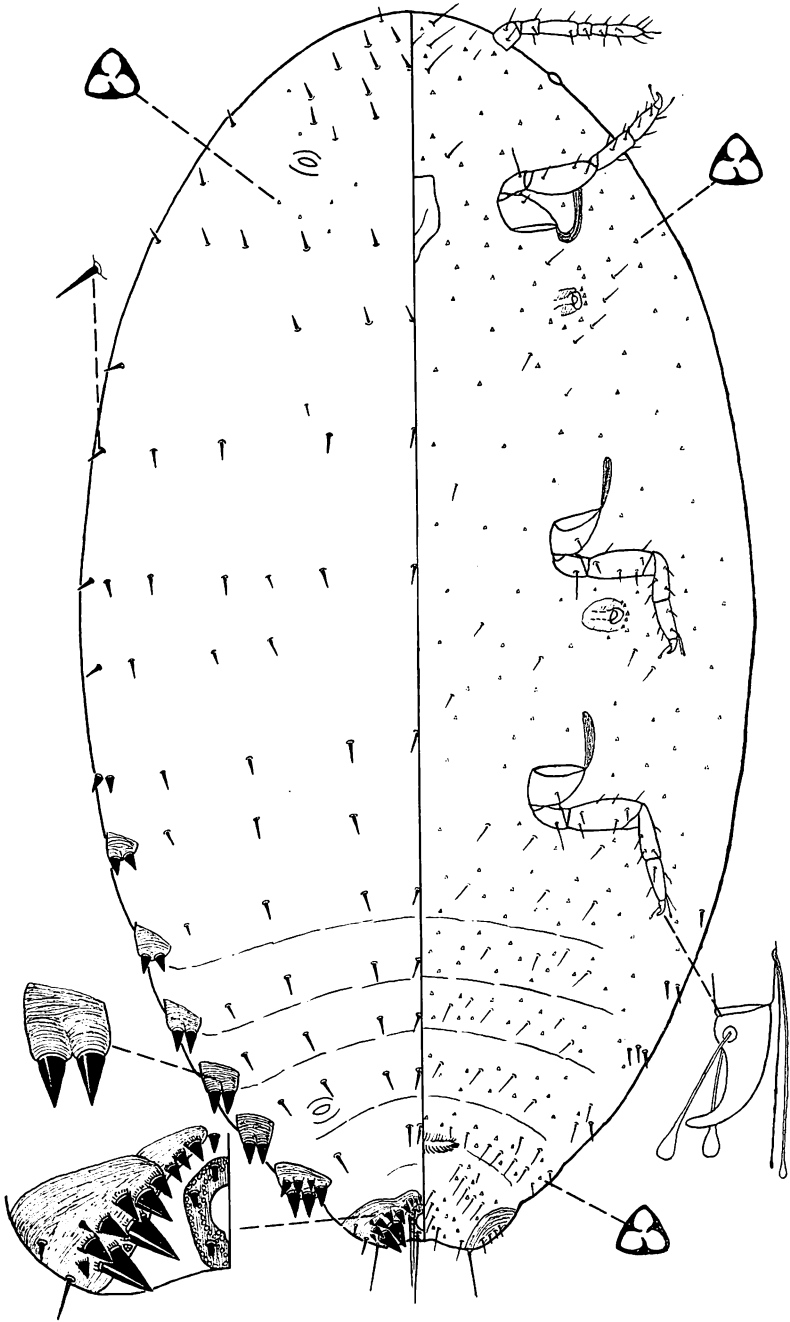
Described from 16 slide-mounted specimens. Holotype and five paratypes on three slides: ex *Dicranopteris linearis*, Mt. Kaala, Oahu, May 20, 1956, J. W. Beardsley collector. Ten paratypes on six slides: same host, Manoa Cliff Trail, Mt. Tantalus, Oahu, January 22, 1956, J. W. Beardsley collector. Holotype and nine paratypes in the collection of the Experiment Station, H.S.P.A., Honolulu; six paratypes in the Bernice P. Bishop Museum, Honolulu.

Wherever found, this species is associated with a particular deformation of the host fern. The mature mealybugs are always found within what appear to be incompletely unrolled pinnule tips. Apparently, the feeding of the young mealybugs aborts the unrolling of the developing pinnules of young fronds and results ultimately in the formation of a hard, gall-like roll at the apex of each pinnule so affected (fig. 3, c). Within each such roll are two chambers, one on either side of the midvein, either one or both of which may be inhabited by an individual mealybug. The presence of this species can be spotted easily on plants in the field, as the aborted pinnules of mature fronds are conspicuously shorter than those which have developed normally.

Young mealybugs, including the immature last-stage females, are yellow-orange in color, oval, and rather flat, with the two small cephalic humps discernible in front of and between the antennae. Wax pencils are confined to the posterior three or four pairs of cerarii. Those of the anal pair are about two-thirds as long as the maximum width of the dorsum; the anterior pencils are shorter. The fully mature females of this species become heavily sclerotized and are dark reddish-brown in color. At this stage they lie seedlike within the aborted pinnules and apparently are incapable of locomotion. This appears to be an ovoviviparous species. No eggs or ovisac were ever found, although crawlers were frequently associated with mature females. Male cocoons occasionally were found within the rolled pinnule tips, and winged males, similar to those of other Hawaiian species of *Pedronia*, were reared. An endemic *Anagyrus*, the same or very similar to that reared from *P. hawaiiensis*, was bred from specimens of this mealybug collected on Mt. Tantalus, Oahu.

#### ***Pedronia crypta*, new species (fig. 4)**

Female. With seven or eight definite pairs of cerarii, those of abdominal segments three to nine present in all specimens at hand. Anal cerarii each within a definitely sclerotized area which extends in an arc nearly to the mid-dorsal line in front of the anus. The six pairs of cerarii anterior to the anal pair each borne on a sclerotized prominence. Each cerarius with two large, stout, conical setae. Anal cerarii each with seven to ten smaller accessory conical setae of various sizes which form an arc reaching nearly to the



mid-dorsal line within the extended sclerotized area. Penultimate cerarii each with two to four such accessory conical setae. Anterior pairs usually without accessory conical setae (although in one paratype there is one such seta on each cerarius of the seventh abdominal segment). Conical setae of anterior cerarii slightly smaller than the large pair of the anal and penultimate cerarii. Cerarii of the second abdominal segment sometimes lacking, if present not borne on a sclerotized prominence.

Cerarii without visible concentrations of trilocular pores, with but one such pore discernible between the largest conical setae of each anal cerarius. Trilocular pores of the dorsum few, not more than six or seven discernible, scattered in the vicinity of each anterior dorsal ostiole. Ventral trilocular pores fairly numerous, scattered, somewhat more concentrated on the posterior abdominal segments. Pores concentrated slightly around spiracular orifices.

Ventral portion of anal lobes slightly sclerotized. Spiracles each enclosed in a small sclerotized area. Dorsal setae enlarged, thickened basally, those of the abdomen arranged roughly in transverse rows. Setae of venter scattered, of normal form except for a few similar to those of the dorsum along the lateral margins of the abdomen.

Antennae rather short, six-segmented in all but one specimen (that with one six-segmented and one seven-segmented). Legs, particularly the femora, appearing shorter and stouter than in the previously described species of the genus.

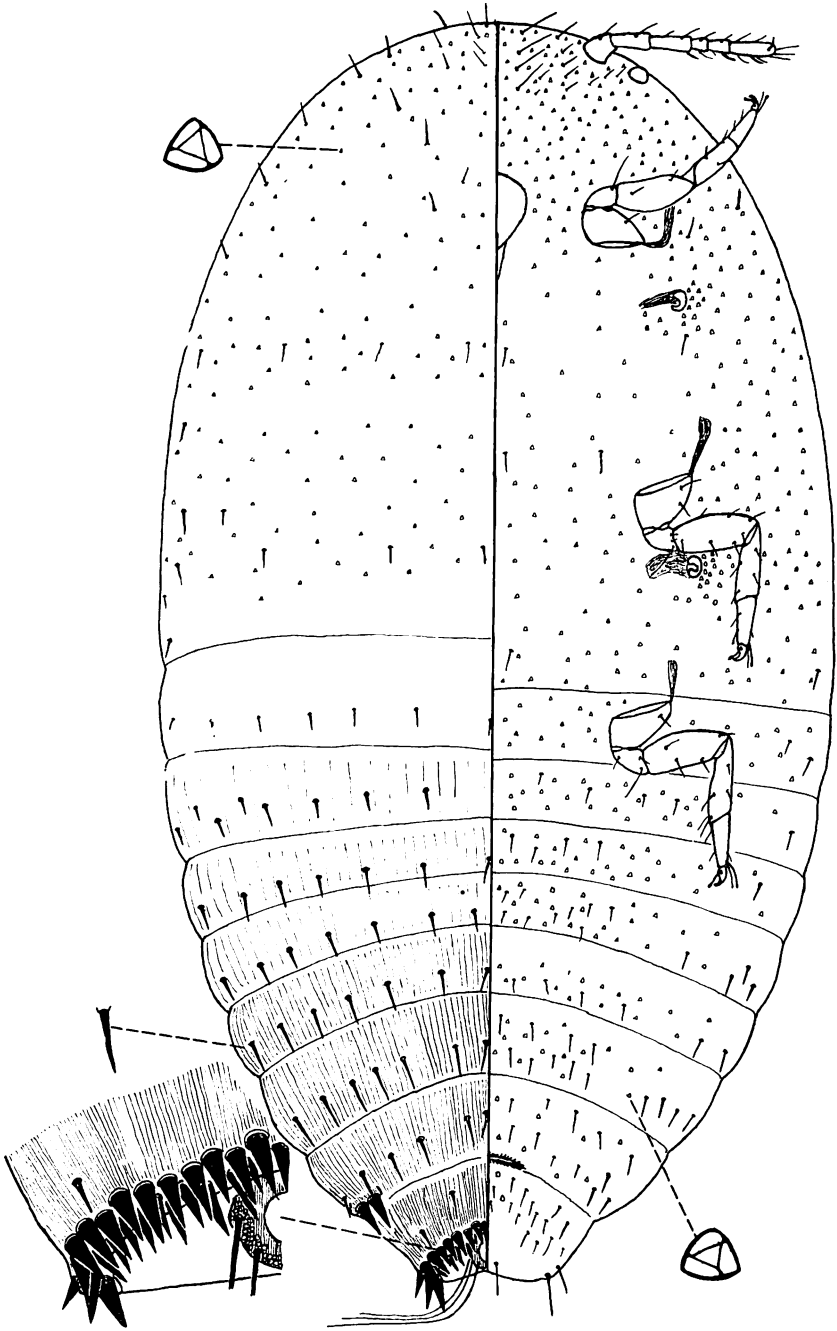
Length on slides: 1.7–2.3 mm.

Described from five fully mature specimens (holotype and four paratypes on three slides) recovered from a herbarium specimen of *Dicranopteris owbyhensis* Hooker in the Bernice P. Bishop Museum, Honolulu. The herbarium sheet bears the following information: Board of Agriculture and Forestry Herbarium; number 4047; collector, Brodie; locality, Kauai. The collector was probably the late Mr. Alexander Brodie, a chemist and amateur botanist who was employed at a sugar plantation on Kauai prior to 1918. No more exact locality information is available.

Holotype and two paratypes deposited in the collection of the Experiment Station, H.S.P.A., Honolulu; two paratypes in the Bernice P. Bishop Museum, Honolulu.

The type specimens of this mealybug were found in aborted, rolled-over pinnule tips of the host fern which are similar to those produced by *Pedronia dura* on fronds of *Dicranopteris linearis*. A number of male cocoons, presumably of this species, were present on the under side of the frond from which the female specimens were recovered.

Several mummified females showing parasite exit holes were found on the



herbarium specimen with the type material. One intact mummy yielded a fully developed, but slightly teneral, female *Anagyrs*, apparently an endemic species allied closely to those reared from species of *Pedronia* on Oahu.

***Pedronia acanthocauda*, new species (fig. 5)**

Female. With but two definite pairs of cerarii, those of abdominal segment eight bearing two large, stout, conical setae set close together on a small prominence. Anal cerarii represented by a solid phalanx of about forty such conical setae which extend, two or three deep, across the mid-dorsal axis along the posterior margin of the ninth abdominal segment. That segment somewhat produced posteriorly, causing the anal ring to appear slightly invaginated.

Trilocular pores fairly numerous, scattered on dorsum of head and thorax, apparently absent from dorsum of abdomen and the cerarii. Numerous scattered trilocular pores on venter of head and thorax, becoming less numerous or absent on the posterior abdominal ventrites. Slight concentrations of these pores about the spiracular openings.

Dorsum of abdominal segments six to nine rather heavily sclerotized throughout, segments three to five less noticeably so. Dorsal ostioles apparently absent in mature females (although the anterior pair is discernible in several nymphs at hand). Dorsal abdominal setae, particularly those of the posterior segments, enlarged and basally thickened, arranged roughly in transverse rows. A few less noticeably enlarged setae present on head and thorax. Ventral setae rather sparse and of normal size, except for a few more strongly developed ones along the lateral margins of the abdomen. Anal ring well developed, the usual six setae unusually long.

Antennae moderately short, six-segmented in all specimens at hand. Legs, particularly the femora, rather short and stout, resembling those of *Pedronia crypta*.

Length on slides: 1.4–2.1 mm.

Described from eight fully mature specimens (holotype and seven paratypes on eight slides) recovered from herbarium specimens of *Dicranopteris owbyhensis* Hooker in the Bernice P. Bishop Museum, Honolulu. The holotype and three paratypes were taken from material collected on Mt. Kona-huanui, Oahu, July 3, 1872, by Hillebrand and Lydgate. Four paratypes were recovered from host material collected at the peak of Mt. Konahuanui, Oahu, March 14, 1920, by D. W. Garber. A number of immature or inferior specimens were also taken from these herbarium sheets.

Holotype and three paratypes deposited in the collection of the Experiment Station, H.S.P.A., Honolulu; four paratypes deposited in the Bernice P. Bishop Museum.

This species was found within the same sort of aborted, rolled-over pinnule tips as were *Pedronia dura* and *P. crypta*. Although some of the specimens,

including the holotype, were nearly 85 years old when removed from the host material, they were still in excellent condition. This certainly is evidence of the excellent care which the Bishop Museum herbarium has enjoyed these many years.

*Pedronia acanthocauda* seems to be closely allied to *P. crypta* from Kauai, and also, although less obviously, to *P. dura*. Both *P. acanthocauda* and *P. crypta* probably still occur in the more remote mountain areas where their host is found.

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